Effects of Alcohol upon Speed Anticipation Reaction Test and Discriminative Reaction Test of Multiple Performance Type

EFFECTS OF ALCOHOL UPON SPEED ANTICIPATION REACTION TEST AND DISCRIMINATIVE REACTION TEST OF MULTIPLE PERFORMANCE TYPE

by

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Introduction

It is natural that we should think that alcohol reduces the control functions of consciousness and impedes the functions of such as attention, control and sensory-motor coordination. According to Rogers, D.B.,[1] even small amounts of alcohol produce muscular incoordination, reduce sensory discrimination, and increase errors in judgment..... it does not increase efficiency. In other words, alcohol is thought to be a general efficiency reducer.[2,3,4] Lauer,[5] who studied the effects of alcohol on functions relating to driving performance through such as complex reaction time experiment etc., says that by the intake of alcohol the greatest loss of efficiency is found in abilities relating to judgment and their finer coordinations and that some of the noticeable effects of alcohol on functions relating to driving performance seem to (a) be heightened variability and inconsistency in performance, erratic behavior, (b) increase in length of reaction time.... presumed to be detrimental and (c) tendency to hurrying performance and being less cautious.

Recently we contrived a test battery arranged for Speed Anticipation Test[6] and Discriminative Reaction Test of Multiple Performance Type.[7] Both tests are chiefly concerned with the coordination of perceptual-motor functions, i.e., the coordination of precise cognition of stimulus and of motor reaction performance according to the cognition. In the latter test, especially, the complexity of the task was introduced and the multiplicity of performance was required. The most important factor in these two tests may be thought to be the factor of inhibition of hasty reactions.

As a result of the application of the tests to drivers, it was ascertained that the test battery was useful for the discrimination of non-accident and accident-drivers.[6,7] The finding was, in a word, that the accident drivers revealed "hasty" reactions, less control of performance, and worse distribution of attention.

The purpose of the present study is (1) to accumulate some basic evidences concerning the test battery, in view of little objective evidence being presented, although much have been said about the effects of alcohol upon driving

performance, and (2) to investigate whether such detrimental conditions as pointed above as characteristics of accident drivers would be caused by alcohol in normal Ss also or not.

Experiment I : Effects of Alcohol upon Speed Anticipation Reaction Test

Procedure

A small round light patch which glides at a constant speed from right to left in the visual field goes behind a black wall in a short time. Supposing that the gliding light patch will pass behind the black wall at a constant speed, S presses a key the moment he thought the patch just came out from behind the wall. The objective time interval the light patch takes to pass behind the black wall (this we call "correct" or "right anticipation time") is 2080 ms.

In the present experiment, the estimation of time was carried out in the following two ways. (a) By *motor action* of pressing the key (Key pressing series) and (b) by *oral report* without key pressing reaction (Oral series). In the Oral series the detailed procedure is as follows. Experimenter presents various time intervals, e. g., 2000 ms, 2020 ms, 2040 ms, ..., 2080 ms, ... 2120 ms etc., randomly, set up at 20 ms interval, with 2080 ms as a central one. When lights are presented at varied intervals, S estimates and judges as to whether it is faster, just, or slower than he anticipated and, reports orally, "faster," "just," or "slower".

25 Ss in all were divided into two groups, that is, Key pressing group (13 Ss) and Oral group (12 Ss). In each group, also, Ss were divided into minor groups, (a) alcohol group (7 Ss) and (b) control group (6 Ss) in the key pressing series, and each of 6 Ss in the Oral series. In alcohol group, measurement was carried out before and after the intake of alcohol*, whereas in control group it was done in much the same lapse of time as in the alcohol group.

Results

Anticipation time estimated by S is shown by the mean value of ten times key pressing responses in the Key pressing group and that in the Oral group is the mean of the time range when the judgement of "just" was repeated by Ss.

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* The way of giving Ss alcohol was as follows. In order to facilitate intoxication, Ss drank *Sake*, a familiar liquor to them, at about one p. m. without lunch, in a small comfortable room in the laboratory. Classmates drank in pairs as Ss, in the natural friendly atmosphere, about 360 cc warmed (about 60° C) *Japanese sake* (first class 16% proof *sake*). Hors d'oeuvre was also served. Immediately after drinking for about 30 to 50 minutes, the degree of intoxication was measured by the Kitagawa intoxication detector.
For the particulars, see references by Kikuchi, T. et al. [8]

Table 1. Result of Speed Anticipation Reaction Test

Group / Series	Control group					Alcohol group					P
	N	before*	after**	difference	rate of increment	N	before*	after**	difference	rate of increment	
Key pressing series	6	ms 2195	ms 2229	ms +34	% +1.5	7	ms 2567	ms 2162	ms −405	% −15.8	.05
Oral series	6	ms 2228	ms 2255	ms +28	% +1.3	6	ms 2175	ms 2343	ms +186	% +7.7	NS

* "before" means "before thetintake of alcohol"
** "after" means "after the intake of alcohol"

Table 1 shows that in the Key pressing series after the intake of alcohol the alcohol group reacted faster than in normal condition, the rate of decrease being 15.8%. In the control series there appeared 1.5% of increase in the post measurement compared with the pre-measurement. The difference between 15.8% in the alcohol group and 1.5% in the control group is statistically significant ($t=2.06$ $df=11$, $p<.05$). In Oral series, however, no significant difference was found between the two groups. With regard to the coefficient of variation (V), another index of the test, there was no difference between two groups in each series.

Discussion

In the measurement mentioned above, different Ss were assigned to each of four groups. Here arises, therefore, a problem to what degrees the scores of motor (Key pressing) reactions accord with that of Oral reaction. Our additional experiment shows that there was found a high degree of agreement between the anticipation time by key pressing and that by oral report for the standard Ss, whose anticipatibn time by key pressing was above 1501 ms. For the hasty Ss, whose anticipation time was below 1500ms., there was little accord between the two kinds of anticipation time, as shown in Table 2.

Table 2. Result of key pressing and oral report condition in the same S.

Condition / Group	N	Key pressing (A) condition	Oral report (B) condition	difference (A)−(B)	$\frac{(A)-(B)}{(B)}\times 100$
Standard Ss*	12	ms 1920	ms 1922	ms −2	% −0.1
Hasty Ss**	7	ms 1047	ms 1251	ms −204	% −16.3

* Those who showed anticipation time of"1501ms and above" in the Key pressing reaction.
** Those who showed anticipation time of"1500ms and below"in the Key pressing reaction.

While the standard Ss showed a slight difference of −0.1% between time intervals by key pressing and by oral report, the hasty Ss showed −16.3% of difference. This results show that motor (key pressing) reaction exceeded the cognition for the hasty Ss in the key pressing condition. This suggests his weakness in the motor inhibition in a broad sense to control the hasty motor expressions.

Now, all of the Ss in the present experiment except one, who belongs to oral series in control group, showing 1425 ms. in the pre-measurement and 1650 ms. in the post-measurement, were the standard Ss whose anticipation time was above 1501 ms. They may be regarded as homogeneous Ss, partly because little difference was found in the pre-measurement scores among four groups and partly because no statistical basis is furnished for thinking them as heterogeneous Ss.

On condition that all the Ss who participated in the present experiment were standard and homogeneous Ss, the following conclusion can be drawn from the results described above.

The intake of alcohol did not affect the inner levels of judging time interval presented, but did the reaction performance (motor action). The shortening of anticipation time judged in the key pressing series, which we called "hasty reactions", may be attributable to the weakening of function of "motor inhibition" in a broad sense by alcohol intake. This is because the factor of inhibition of hasty reaction plays an important role in this Speed Anticipation Reaktion Test.

Experiment II : Effects of Alcohol upon Discriminative Reaction Test of Multiple Performance Type

Procedure

On the black screen standing about 1m ahead of S, there are on the eye's level three round small windows which are provided with green, yellow and red lamps from left to right. Each lamp is connected with the right hand key, the left hand key and the right foot key. Behind the screen, there are a chronometer and a buzzer. S is instructed to react as fast and correctly as possible, just before the test. S pushes all the keys at the signal of "ready" by E each time and reacts by letting go the adequate corresponding key as soon as he perceives one of the three kinds of lamps. 16 trials in all were assigned. At the back of the screen E measures the reaction time and error reaction. The above is the lst series of the Experiment II. Immediately after the lst series, the 2nd series was assigned to Ss.

The task in the 2nd series is more complicated than in the 1st series, with 16 trials in the same way as in the 1st series.

In the 2nd series, the following tasks were added to the "simple" task of reaction described above (lst series).

1. The task of giving no response when the buzzer goes simultaneously with lamp 4 times out of 16 trials, as a sign of requiring inhibition of response.

2. The task of counting how many times each of the three kinds of stimulus lamps were presented. S must report the result of the counting after the end of 16 trials.

Ss were 26 students in all. They were divided into two groups: alcohol group (13 Ss) and control group (13 Ss). Experiments were carried out in the order of 1st

and 2nd series. In alcohol group, measurement was carried out before and after the intake of alcohol, while measurements for control group were carried out at the same time intervals as for the alcohol group.

Results

Table 3. Result of Discriminative Reaction Test (1st series)

Index \ Group	Control group (N=13)				Alcohol group (N=13)				P
	before	after	difference	rate of increment	before	after	difference	rate of increment	
Reaction time (RT) (ms)	639.0	606.8	−32.2	−5.04%	669.6	700.3	+30.7	+4.58 %	.05
Coefficient of variation (V) (%)	13.3	14.5	+1.2	+9.02%	13.3	16.8	+3.5	+26.3 %	NS
Error reaction (E) (times)	1.84	1.53	−0.31	−16.8%	2.08	1.77	−0.31	−14.9 %	NS

Table 4. Result of Discriminative Reaction Test (2nd series)

Index \ Group	Control group (N=13)				Alcohol group (N=13)				P
	before	after	difference	rate of increment	before	after	difference	rate of increment	
RT (ms)	771.0	726.8	−44.2	−5.73	824.0	851.7	+27.7	+3.36	.05
V (%)	21.23	18.17	−3.06	−14.4	17.8	21.8	+4.0	+22.5	.05
E (times)	2.61	1.84	−0.77	−29.5	1.92	1.53	−0.39	−20.3	NS
Counting	3.15	1.61	−1.54	−48.8	3.23	3.0	−0.23	−7.1	.05

Results of the lst series are shown in Table 3 and those of the 2nd in Table 4. In both series the delay of mean reaction time was found for thc alcohol group. In the first series the mean reaction time increased by 4.58% after the intake of alcohol compared with that before the intake. In the control group, there was 5.04% decrement. The difference between two groups is significant at the 5% level of confidence ($t_0=1.84$, $f=24$, $p<.05$). In the second series the increment of the reaction time for the alcohol group was 3.36%, whereas in the control group the reaction time decreased by 5.73%, the differnce between two groups being significant ($t_0=1.80$, $df=24$, $p<.05$). The coefficient of variation, the second index of the Discriminative Reaction Test, grew larger in the second series where the task was more complicated than in the first series. The variation increased by 22.5% in the alcohol group, while it decreased by 14.4% in the control group, the difference between the two group being significant at 5% level of confidence ($t_0=2.97$, $df=24$, $p<.05$).

In the task of counting the times of presentation of each of 3 stimuli, a more complicated task in the 2nd series, less decrement of the deviation from the actual

times of presentation was found in the alcohol group, with the result that the rate of decrement is 48.8% in the control group and 7.1% in the alcohol group. The difference between the two groups was significant at 5% level of confidence ($t_0=1.91$, $df=24$, $p<.05$). With respect to another index of the experiment, the index of error reaction (reaction of not letting go the adequate key), there was little difference between two experimental conditions.

Discussion

In the Discriminative Reaction Test of Multiple Performance Type, alcohol did not increase the error reaction, but brought about the delay and fluctuation of reaction. That is, the control function of consciousness was reduced by alcohol, and the reaction performance was retarded, resulting in the delay and the unevenness of reaction.

These findings are, in principle, in agreement with the evidence which has been reported so far. That is, alcohol has an injurious effect on psychomotor functions and particularly on the choice reactions, lengthening the reaction time and increasing errors ; it also diminishes voluntary attention[9], and much slower and increasing variable reactions are consistently shown after the use of alcohol.[10] Besides these, the findings by Lauer[5] described above are in almost the same direction as our findings. Here we will refer further to the fact that few error reactions were found in our experiment. Though there were few changes in error reaction, they may seem so, but the errors appeared under another form: the increment of reaction time and of coefficient of variation. Perhaps voluntary, controlled distribution of attention would be impeded by drinking, and only "the set not to make any errors" may have survived on the part of S.

Summary

Effects of alcohol upon Speed Anticipation Reaction Test and Discriminative Reaction Test of Multiple Performance Type were experimentally investigated. There appeared definite changes in both tests. Specifically, in the former, the reduction of anticipation time was founed (under Key pressing condition) and in the latter, increased reaction time, increased coefficient of variation and poor scores in an additional task (the counting task) were observed. The results of the former seem to show that by the intake of alcohol a hasty reaction tendency or a hurry performance tendency increased. The latter will suggest that alcohol had a detrimental effect on some psychomotor function, making worse perceptual-motor coordination and ability to concentrate attention. These were almost the same tendencies shown by the accident drivers.

References

(1) Rogers, D. B., Psychological effects of diet and drugs. In Gray, J. S. (Ed.), Psychology Applied to Human Affairs. 2nd ed. N. Y. : McGRAW HILL, 1954. p. 292.

(2) Switzer, St. C. A., Drugs and smoking. In Fryer, D. H. and Henry, E. R. (Eds.), Handbook of Applied Psychology. Vol. 1., N. Y.; RINEHART, 1950. p. 88.

(3) Bahnsen, P., and Vedel-Peterson, K., Alcohol studies: I. Experiments on drivers of motor vehicles. J. industr. Hyg., 1934, 16, 304-322. *cited by Marshall, H. in "Alcohol a critical review of the literature, 1939-1940" Psychol Bull.*, 1941, 38, 193-217.

(4) Schmidt, M.,Alcohol studies: concentration of alcohol in the blood. J industr. Hyg., 1934, 16, 355-365. *cited by Marshall, H. Op. cit., p.* 202.

(5) Lauer, A. R., The Psychology of Driving-Factors of Traffic Enforcement. Charles C Thomas, Illinois. 1960.

(6) Maruyama, K. and Kitamura, S. , Speed Anticipation Test: A test for discrimination of accident proneness in motor drivers, Tohoku Psychologica Folia, 1961, 20, 13-20.

(7) Nagatsuka, Y., and Kitamura, S., Discriminative Reaction Test of Multiple Performance Type: A test for discrimination of accident proneness in motor drivers. Tohoku Psychol. Folia, 1961, 20, 21-34.

(8) Kikuchi, T., Kitamura, S. and Oyama, M. , Rorschnch Performance in Alcoholic Intoxication, Tohoku Psychologica, Folia, 1961, 20, 45-71.

(9) Varé, P., Influence de l'alcool sur les réactions psychomotrices. C. R. Soc. Biol. Paris, 1932, 111, 70-72. *cited by Marshall, H. Op. cit., p.* 203.

(10) Mayerhofer, G.,Recherches psycotechniques concernant l'effect de l'alcool sur le comportment des conducteurs d'antomobiles. Travail hum., 1933, 1, 257-277. (psychol. Abstr., 8, 561.) *cited by Marshall, H. Op. cit.*, p. 208.

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Zusammenfassung

Die Veränderung der Leistungen in der alkoholischen Betrunkenheit wurde mittelst der Püfung des Geschwindigkeitsanschlags und der Auswahlprüfung (ein aus mannigfaltigen Ausgaben bestehendes Wahlreaktions-experiment) sowohl an der alkoholischen Gruppe als auch an der kontrollierten Gruppe von je 13 Vpn. untersucht.

Die Ergebnisse lassen sich folgendermassen zusammenfassen: Bei der Prüfung des Geschwindigkeitsanschlags in der Betrunkenheit, war die Kürzere Reaktionszeit erkennbar und anderseits zeigt sich bei der Auswahlprüfung die längere Reaktionszeit und zugleich vermehrter Abweichungskoeffizient aus der durchschnittlicher Reaktionszeit. Hinsichtlich der Häufigkeit der Fehler-Reaktion zeigte sich hierbei kein bemerkenswerter Unterschied zwischen zwei (alkoholischen und kontrollierten) Gruppen.